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# ORIGINS OF CHINOOK SALMON
# IN THE YUKON RIVER FISHERIES, 1995

By

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## ABSTRACT

Analysis of scale patterns and age composition ratio analysis of chinook salmon *Oncorhynchus tshawytscha* (Walbaum) from Yukon River escapements in Alaska and salmon tagging-study catches in Canada were used to construct classification models for assigning Yukon River District 1 and 2 commercial and subsistence harvests to run of origin. Linear discriminant models were used to estimate stock composition for age-1.3 and -1.4 fish in District 1 and 2 harvests. Observed age composition differences among escapements were used to estimate runs of origin for other age classes. District 3 and 4 commercial and subsistence harvests were assigned to run of origin using the estimated proportions obtained in the analysis of District 2 harvests combined with assignment of Koyukuk River subsistence harvests to the Middle Yukon Run based on geographic occurrence. Runs of origin for all other drainage harvests were estimated based on geographic occurrence. The total estimated Yukon River harvest in 1995 was 198,550 chinook salmon, of which 75% was estimated to be the Upper Yukon Run, 13% the Middle Yukon Run, and 12% the Lower Yukon Run.

## INTRODUCTION

Yukon River chinook salmon *Oncorhynchus tshawytscha* (Walbaum) have historically been harvested in a wide range of fisheries in both marine and fresh waters. Within the Yukon River returning adults are harvested in subsistence fisheries in Alaska, Aboriginal and domestic fisheries in Canada, and commercial and sport fisheries in Alaska and Canada (Figures 1 and 2). Commercial harvests consist of fish sold in the round, numbers of fish contributing to commercial roe production, and fish sold in the round by the Alaska Department of Fish and Game (ADF&G) from test fisheries in Districts 1 and 2. Sport fisheries occur primarily in the Tanana River drainage and in Canada. However, small unreported sport fishing harvests are known to occur elsewhere in the Alaska portion of the Yukon River drainage.

In the 20 years after statehood (1960-1979), the total chinook salmon harvest in the Yukon River in both Alaska and Canada ranged from an estimated 77,000 to 170,000 and averaged 123,000 fish annually (JTC 1994). Beginning in 1980, annual harvests increased substantially. During the most recent 5-year period (1990-1994) total annual catches averaged 186,000 fish. While chinook salmon are harvested virtually throughout the length of the Yukon River, the majority of the catch has been taken in commercial gillnet fisheries in Districts 1 and 2. The 1990-94 average commercial harvest in Districts 1 and 2 was 54% of total drainage harvest, and subsistence harvests in the two districts accounted for another 9%. However, most of the subsistence harvest is taken with fish wheels and gillnets in Districts 4, 5, and 6. In 1995, commercial, subsistence, Aboriginal, domestic, and sport fishermen in Alaska and Canada harvested an estimated 198,550 Yukon River chinook salmon, of which 117,564 fish (59.2%) were taken by District 1 and 2 commercial fishermen (Bergstrom *et al.* 1997).

Chinook salmon harvested in the Yukon River fisheries consist of a mixture of stocks bound for spawning areas throughout the Yukon River drainage. Although more than 100 spawning streams have been documented, aerial surveys of chinook salmon escapements indicate that the largest concentrations of spawners occur in three distinct geographic regions: (1) tributary streams in Alaska that drain the Andreafsky Hills and Kaltag Mountains between river miles 100 and 500, (2) Upper Koyukuk River and Tanana River tributaries in Alaska between river miles 800 and 1,100, and (3) tributary streams in Canada that drain the Pelly and Big Salmon Mountains between river miles 1,300 and 1,800. Chinook salmon stocks within these geographic regions were collectively termed runs by McBride and Marshall (1983) and are now referred to as the Lower, Middle, and Upper Yukon Runs.

Evaluating stock productivities, spawning escapement goals, and management strategies requires information on the stock composition of the harvest. In addition, the U.S. and Canada are engaged in treaty negotiations concerning management and conservation of stocks spawned in Canada. Biological information on these stocks provides the technical basis for the negotiations.

Harvest estimates of western Alaskan and Canadian Yukon River chinook salmon in the Japanese high seas gillnet fisheries were made using scale pattern analysis (SPA; Rogers et al. 1984; Meyers et al. 1984; Meyers and Rogers 1985). Stock composition of Yukon River fisheries has been studied by the Alaska Department of Fish and Game to provide postseason information for management and conservation of the various runs of chinook salmon. For Yukon River chinook salmon, stock composition estimates derived from scale pattern analysis of the catch through time were first available for 1980 and 1981 District 1 harvests (Schneiderhan 1997). Since then, harvest proportions by geographic region of origin have been estimated annually for the entire drainage (Schneiderhan 1997).

The objective of this study was to estimate the run of origin of all Yukon River chinook salmon harvests for the 1995 season.

# METHODS

Schneiderhan (1997) provides a historical perspective including evolved methodology of SPA from 1981 to 1997 as it has been applied to Yukon River chinook salmon. Current methodology described by Schneiderhan (1997) was employed for the analysis presented here.

Scale samples provided age information for fish in the catch and escapement. Scales were collected from the left side of the fish approximately two rows above the lateral line in an area transected by a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (Clutter and Whitesel 1956). Scales were mounted on gummed cards and impressions made in cellulose acetate. Scale impressions were then projected on a digitizing table at 100X magnification, and scale variables were measured (Figure 3). Measurements were automatically recorded in computer files for later statistical analysis. Ages were reported in European notation.

## *Catch Sampling*

Scales were collected from commercial catches in all fishing districts except District 3. There were no chinook salmon commercial harvests in District 3 in 1995. Subsistence catches in Districts 4 and 6 were also sampled. For purposes of this report, I assumed that subsistence fishing in Districts 1 and 2 occurred prior to or near the beginning of commercial fishing and could therefore be described using the Period 1 commercial sample data for each district. In addition, samples were collected from salmon harvested by the District 1 ADF&G gillnet test fishing project and from fish captured in fish wheels by the Canada Department of Fisheries and Oceans (DFO) in Yukon, Canada.

## *Escapement Sampling*

Spawning escapements for the three Yukon River chinook salmon runs were characterized by age composition. Scale samples for age information were collected during the period of peak spawner mortality from the Anvik, Chena, and Salcha Rivers in Alaska. Carcasses were the primary source of samples; however, some samples were obtained from live fish captured with spears or other methods. Live salmon from the Andreafsky River were sampled at a weir project operated by U. S. Fish and Wildlife Service (FWS). Chinook salmon in Canadian tributaries were not sampled in 1995; however, the Canadian border passage of chinook salmon was sampled at DFO fish wheel sites prior to entry of the run into Canadian Yukon River fisheries.

Since comparable escapement estimates for the Lower Yukon Run tributaries, i.e., Andreafsky and Anvik Rivers, were not available as weighting factors, the age composition of the Lower Yukon Run was estimated using the pooled Andreafsky and Anvik River samples. The Chena and Salcha River escapements, which are used to characterize the Middle Yukon Run, had abundance estimates of comparable quality that were used as weighting factors in conjunction with sample age compositions to obtain an estimate of age composition for the run. The age composition obtained from samples collected at the two DFO salmon tagging sites was used to characterize the spawning escapement for the Upper Yukon Run.

### *Estimation of Catch Composition*

Linear discriminant analysis (LDA, Seber 1984) of scale pattern data, observed differences in age composition between escapements, and geographic occurrence of catches were used to estimate runs of origin for 1995 Yukon River chinook salmon catches.

## RESULTS

### *Escapement Age Composition*

Estimated spawning escapement age compositions of Yukon River chinook salmon in 1995 exhibited some differences (non-statistical comparison) between lower and middle Yukon River escapements (Table 1). The samples listed in Table 1 for the White Rock and Sheep Rock sites are not representative of the spawning escapement, because Canadian fisheries upstream resulted in removal from the sampled population after it passed the sampling sites, and fishwheels are thought to capture chinook salmon selectively. However, no spawning escapement sampling was conducted for upper Yukon River stocks in 1995. Fish wheels operated at the White Rock and Sheep Rock sites provided samples that were imperfectly comparable to the spawning ground samples obtained prior to 1991.

All escapement sample size objectives were achieved. Age-1.4 fish were more abundant than age-1.3 fish in lower, middle and upper Yukon River escapements. This has been noted in other years. The large proportions of age 1.4 from the 1989 brood year that were present in 1995 middle Yukon

River escapements were reflected in large proportions of age 1.3 for the same brood year in 1994 escapements (Schneiderhan 1996).

## *Catch Composition*

### Scale Pattern Analysis

The scale measurement characters (Appendix A) that were used in distinguishing between the three runs of origin for age 1.3 were (1) variable 15, the distance of circulus 4 to the end of the first freshwater annular zone, (2) variable 111, the total width of marine zones, and (3) variable 66, the total width of the freshwater zone.

The primary distinguishing characters for age 1.4 in order of selection were (1) variable 15, described above, (2) variable 111, described above, and (3) variable 18, the distance from circulus 0 to circulus 8 divided by the distance of the first freshwater annular zone. Variables 12, 82, 1, 8, and 107 were also selected. Variables involving freshwater and freshwater plus growth typically accounted for most of the discriminatory power in both models. Variables selected for the classification model are presented in Appendix B with mean and standard error for each run of origin. Group means and standard errors for the number of circuli and width of the first freshwater annular, plus growth, and marine annular zones are listed in Appendix C.

### Classification Accuracies of Run of Origin Models

A 3-way (Lower, Middle, Upper) classification model was developed using linear discriminant functions (Seber 1984). Classification accuracies were investigated by comparing the true run of origin with that predicted by the model for each scale used in development of the model. The mean classification accuracy of the 3-way, run of origin model for age 1.3 was 72.0%, and for age 1.4 it was 66.0% (Table 2). This is comparable to accuracies normally achieved with 3-way models used in other years. Also, similar to past years, the lower river standard showed the greatest classification accuracy for age 1.4 (71.2%); however, unlike most past years, the upper river standard for age 1.3 showed the highest classification accuracy (81.3%) of the three runs. Upper river standards most often misclassified to the Middle Yukon Run (18.8% for age 1.3 and 26.0% for age 1.4), and middle river standards most often misclassified to the Lower Yukon Run (16.7% for age 1.3 and 22.4% for age 1.4). Historically, the Middle Yukon Run has typically misclassified to the Upper Yukon Run more strongly than to the Lower Yukon Run.

### Proportion of Catch

The majority of the commercial chinook salmon catch in Districts 1 and 2 was taken in the first three fishing periods. Upper Yukon Run fish comprised the largest proportion of the District 1 commercial harvest of age-1.3 chinook salmon in periods 1, 2, 4, and 5. Upper run fish comprised the largest proportion of District 1 harvests of age 1.4 in periods 1 - 3 (Table 3). Similarly, in District 2 Upper Yukon Run fish were the largest proportion of the catch of both age 1.3 and 1.4 in all periods (Table 4).

Usually, Upper Yukon Run fish tend to dominate the harvest during the early commercial fishing periods in District 1 and gradually decrease during the later periods. In 1995 this trend was apparent for age 1.4 but not for age 1.3 (Figure 4). Age-1.3 Upper Yukon fish showed a relatively high contribution across the first five periods, except for a drop in period 3. Run contribution estimates for age-1.3 salmon through time in District 1 demonstrated increasing proportions of Lower Yukon fish to the midpoint of the harvest followed by decreasing proportions thereafter, which is unlike most previous years. In terms of numbers of fish caught in District 1 commercial periods (Figure 5, Table 5), generally, more Upper Yukon fish were caught in earlier periods.

In District 2, proportions of Upper Yukon Run fish remained uniformly high throughout the season for both age 1.3 and 1.4 (Figure 6), and the Upper Yukon Run fish dominated catches in numbers of fish for each period (Figure 7).

The estimated District 1 commercial catch of age-1.3 and -1.4 fish combined was 14,489 (20.6%) Lower, 9,578 (13.7%) Middle, and 46,173 (65.7%) Upper Yukon Run (Table 5). In District 2 the estimated age-1.3 and -1.4 combined catch was 3,768 (9.9%) Lower, 2,934 (7.7%) Middle, and 31,419 (82.4%) Upper Yukon Run (Table 6).

**Classification by SPA Analysis**

A total of 108,361 age-1.3 and -1.4 fish (54.6% of the total drainage harvest) from District 1 and 2 commercial catches were directly classified to run of origin based on results of scale pattern analysis. Additionally, 30,046 (15.1% of the total drainage harvest) age-1.3 and -1.4 fish caught in Districts 1 and 2 subsistence fisheries and Districts 3 and 4 commercial and subsistence fisheries were indirectly classified based on the scale pattern analysis.

**Classification by Differential Age Composition Analysis**

The remaining age classes (0.2, 1.1, 0.3, 1.2, 0.4, 2.2, 2.3, 1.5, 2.4, and 2.5) from Districts 1, 2, 3, and 4 commercial and subsistence catches contributed 11,697 fish (5.9%) to the total drainage harvest (Table 7). With the exception of 1,505 fish taken in the Koyukuk River subsistence fishery and 434 fish taken in Chandalar River and Black River subsistence fisheries, they were classified to run of origin by applying differences in escapement age composition in each run to classifications derived from the analogous major age class, i.e., age 1.3 or 1.4, through SPA (Schneiderhan 1997).

**Classification by Geographical Analysis**

The Koyukuk River subsistence catch of 1,505 fish in District 4 is represented in the numbers of fish reported in the above sections on SPA and age composition analysis; however, the Koyukuk fish were classified to the Middle River Run based on geographical segregation as explained above. Additionally, a total of 48,446 fish (24.4% of total drainage harvest) in Districts 5, 6, and Yukon Territory was classified to run of origin based on geographical segregation. With the exception of Chandalar River subsistence catches, District 5 and Yukon Territory harvests were assumed to be Upper Yukon fish. The Chandalar River subsistence catch in District 5 was classified to the Middle

River Run based on geographical segregation from stocks of the Upper River Run, i.e., Canadian origin. Harvests in District 6 (Table 7) were classified entirely to the Middle Yukon Run based on geographic location of the fisheries.

**Total Harvest**

All identifiable components of the Yukon River drainage harvest of chinook salmon consisting of 198,550 fish were classified to run of origin (Table 7) based on: (1) findings of the scale pattern analyses of age-1.3 and -1.4 fish in District 1 and 2 commercial catches, (2) age composition analyses of the remaining age classes, (3) assumptions concerning unsampled fisheries, and (4) stock origins based on geographical segregation. Allowing for slight rounding error (<1 fish), the Upper Yukon Run was the largest estimated run component and contributed 148,849 fish or 75.0% of the total drainage harvest. The Middle Yukon Run was next in abundance at 25,830 fish (13.0%), followed by the Lower Yukon Run at 23,870 fish (12.0%).

## DISCUSSION

Attainment of sample size objectives presented in the annual sampling plan has been considered to be a fair measure of operational success. For all escapements which contributed to the standard three-way LDF classification model, sample sizes were fair to excellent; however, the low return of age 1.3 chinook salmon and a larger than usual number of undigitizable scales caused smaller than desirable samples of this age class. Acceptable sample quality depends on environmental, biological, and methodological factors. When the expected rejection rate is exceeded, the quantity of acceptable specimens may become problematic. The rejection rate attributed to sampling technique is a key factor in determining sample sizes. In order to optimize sampling effort, sampling technique must also be optimized; therefore, the production of good quality samples continues to be very important.

Proportion of total drainage harvest that was attributed to the Upper Yukon Run in 1995 was higher than any previous year in the study. Table 8 presents a summary of the annual estimates of catch composition as presented in each of the annual reports for this project. Estimates of the Upper Yukon Run component have ranged from 35.4% in 1984 to 74.8% in 1995, with an unweighted average of 58.2% since 1982.

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**TABLES**

Table 1. Age proportions of Yukon River chinook salmon escapement samples, 1995.

| Location | Sample Size [a] | 1992 | | 1991 | | 1990 | | | 1989 | | 1988 | | 1987 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 2.2 | 1.4 | 2.3 | 1.5 | 2.4 | 1.6 | 2.5 |
| Lower Yukon | | | | | | | | | | | | | | |
| Andreafsky River | 343 | 0.0000 | 0.0000 | 0.0000 | 0.3499 | 0.0000 | 0.1574 | 0.0000 | 0.4752 | 0.0000 | 0.0175 | 0.0000 | 0.0000 | 0.0000 |
| Anvik River | 404 | 0.0000 | 0.0000 | 0.0000 | 0.0916 | 0.0000 | 0.2376 | 0.0000 | 0.6337 | 0.0000 | 0.0371 | 0.0000 | 0.0000 | 0.0000 |
| Average Proportion | | 0.0000 | 0.0000 | 0.0000 | 0.2208 | 0.0000 | 0.1975 | 0.0000 | 0.5545 | 0.0000 | 0.0273 | 0.0000 | 0.0000 | 0.0000 |
| Middle Yukon | | | | | | | | | | | | | | |
| Chena River | 791 | 0.0000 | 0.0000 | 0.0000 | 0.0443 | 0.0000 | 0.2086 | 0.0000 | 0.7092 | 0.0000 | 0.0341 | 0.0038 | 0.0000 | 0.0000 |
| Salcha River | 546 | 0.0000 | 0.0000 | 0.0000 | 0.1355 | 0.0000 | 0.2051 | 0.0000 | 0.6264 | 0.0000 | 0.0256 | 0.0073 | 0.0000 | 0.0000 |
| Average Proportion | | 0.0000 | 0.0000 | 0.0000 | 0.0899 | 0.0000 | 0.2069 | 0.0000 | 0.6678 | 0.0000 | 0.0299 | 0.0056 | 0.0000 | 0.0000 |
| Upper Yukon (Canada) | | | | | | | | | | | | | | |
| White Rock & Sheep Rock | 825 | 0.0000 | 0.0000 | 0.0000 | 0.2828 | 0.0000 | 0.2245 | 0.0000 | 0.4612 | 0.0000 | 0.0316 | 0.0000 | 0.0000 | 0.0000 |

Column headers: Brood Year and Age Group.

[a] Samples from the Anvik, Chena, and Salcha Rivers were collected from carcasses and live spawnouts captured with fish spears. Andreafsky River samples were from live fish captured in a weir trap, and White Rock and Sheep Rock samples were obtained from fish captured in fish wheels.

Table 2. Classification accuracies of linear discriminant run-of-origin models for age-1.3 and -1.4 Yukon River chinook salmon, 1995.

| Region of Origin | Sample Size | Classified Run of Origin: Lower | Middle | Upper |
|---|---|---|---|---|
| **Age 1.3** | | | | |
| Lower | 59 | 0.644 | 0.254 | 0.102 |
| Middle | 54 | 0.167 | 0.704 | 0.130 |
| Upper | 61 | 0.000 | 0.188 | 0.813 |
| | Mean Classification Accuracy: | | **0.720** | |
| | Variables in Analysis: | | | 15, 111, 66 |
| **Age 1.4** | | | | |
| Lower | 163 | 0.712 | 0.196 | 0.092 |
| Middle | 210 | 0.224 | 0.619 | 0.157 |
| Upper | 100 | 0.090 | 0.26 | 0.650 |
| | Mean Classification Accuracy: | | **0.660** | |
| | Variables in Analysis: | 15, 111, 18, 12, 82, 1, 8, 107 | | |

Table 3. Maximum likelihood run composition estimates for age-1.3 and -1.4 chinook salmon commercial catches in Yukon River District 1, 1995.

| | | | Age 1.3 | | | | Age 1.4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Commercial Fishing Period | Dates | Run-of-Origin | N | P | S.E. | Simultaneous 90% CI [a] | N | P | S.E. | Simultaneous 90% CI [a] |
| 1 | 6/14-15 | Lower | 2 | 0.173 | 0.165 | 0.000 < P < 0.525 | 10 | 0.003 | 0.044 | 0.000 < P < 0.097 |
| | | Middle | 4 | 0.131 | 0.234 | 0.000 < P < 0.629 | 16 | 0.000 | 0.000 | 0.000 < P < 0.000 |
| | | Upper | 9 | 0.696 | 0.184 | 0.303 < P < 1.000 | 74 | 0.997 | 0.044 | 0.903 < P < 1.000 |
| 2 | 6/17-18 | Lower | 4 | 0.327 | 0.138 | 0.033 < P < 0.620 | 19 | 0.132 | 0.074 | 0.000 < P < 0.288 |
| | | Middle | 0 | 0.000 | 0.000 | 0.000 < P < 0.000 | 30 | 0.135 | 0.120 | 0.000 < P < 0.390 |
| | | Upper | 10 | 0.673 | 0.138 | 0.380 < P < 0.967 | 51 | 0.733 | 0.100 | 0.520 < P < 0.947 |
| 3 | 6/21 | Lower | 6 | 0.532 | 0.252 | 0.000 < P < 1.000 | 15 | 0.036 | 0.070 | 0.000 < P < 0.184 |
| | | Middle | 6 | 0.343 | 0.272 | 0.000 < P < 0.921 | 36 | 0.295 | 0.127 | 0.025 < P < 0.565 |
| | | Upper | 3 | 0.125 | 0.149 | 0.000 < P < 0.443 | 48 | 0.670 | 0.102 | 0.453 < P < 0.887 |
| 4 | 6/24 | Lower | 1 | 0.243 | 0.213 | 0.000 < P < 0.697 | 30 | 0.297 | 0.086 | 0.113 < P < 0.480 |
| | | Middle | 1 | 0.000 | 0.000 | 0.000 < P < 0.000 | 31 | 0.192 | 0.119 | 0.000 < P < 0.445 |
| | | Upper | 4 | 0.757 | 0.213 | 0.303 < P < 1.000 | 39 | 0.512 | 0.097 | 0.306 < P < 0.717 |
| 5 | 6/28 | Lower | 2 | 0.477 | 0.253 | 0.000 < P < 1.000 | 41 | 0.461 | 0.094 | 0.261 < P < 0.662 |
| | | Middle | 1 | 0.000 | 0.000 | 0.000 < P < 0.000 | 32 | 0.249 | 0.118 | 0.000 < P < 0.500 |
| | | Upper | 3 | 0.523 | 0.253 | 0.000 < P < 1.000 | 27 | 0.290 | 0.087 | 0.104 < P < 0.476 |

[a] Simultaneous confidence intervals are calculated as $p \pm ((z_{(alpha/2k)})(\text{S.E. of } p))$, where k=3 and $z_{(alpha/2k)}=2.128$.

Table 4. Maximum likelihood run composition estimates for age-1.3 and -1.4 chinook salmon commercial catches in Yukon River District 2, 1995.

| | | | Age 1.3 | | | | Age 1.4 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Commercial Fishing Period | Dates | Run-of-Origin | N | P | S.E. | Simultaneous 90% CI[a] | N | P | S.E. | Simultaneous 90% CI[a] |
| 1 | 6/16-17 | Lower | 3 | 0.391 | 0.182 | 0.005 < P < 0.778 | 11 | 0.050 | 0.072 | 0.000 < P < 0.204 |
| | | Middle | 1 | 0.000 | 0.000 | 0.000 < P < 0.000 | 24 | 0.110 | 0.134 | 0.000 < P < 0.395 |
| | | Upper | 6 | 0.609 | 0.182 | 0.222 < P < 0.995 | 46 | 0.840 | 0.111 | 0.603 < P < 1.000 |
| 2 | 6/20-21 | Lower | 1 | 0.050 | 0.191 | 0.000 < P < 0.456 | 19 | 0.222 | 0.085 | 0.040 < P < 0.403 |
| | | Middle | 4 | 0.405 | 0.316 | 0.000 < P < 1.000 | 21 | 0.029 | 0.126 | 0.000 < P < 0.296 |
| | | Upper | 5 | 0.545 | 0.232 | 0.050 < P < 1.000 | 42 | 0.750 | 0.109 | 0.517 < P < 0.983 |
| 3 | 6/25 | Lower | 2 | 0.221 | 0.186 | 0.000 < P < 0.617 | 9 | 0.000 | 0.000 | 0.000 < P < 0.000 |
| | | Middle | 3 | 0.203 | 0.158 | 0.000 < P < 0.539 | 29 | 0.060 | 0.099 | 0.000 < P < 0.270 |
| | | Upper | 6 | 0.577 | 0.207 | 0.136 < P < 1.000 | 62 | 0.940 | 0.099 | 0.730 < P < 1.000 |
| 4 | 6/27 | Lower | 2 | 0.221 | 0.186 | 0.000 < P < 0.617 | 12 | 0.043 | 0.027 | 0.000 < P < 0.100 |
| | | Middle | 3 | 0.203 | 0.158 | 0.000 < P < 0.539 | 25 | 0.030 | 0.049 | 0.000 < P < 0.135 |
| | | Upper | 6 | 0.577 | 0.207 | 0.136 < P < 1.000 | 64 | 0.927 | 0.076 | 0.765 < P < 1.000 |
| 4 | 6/27 | Lower | 2 | 0.221 | 0.186 | 0.000 < P < 0.617 | 15 | 0.085 | 0.054 | 0.000 < P < 0.201 |
| | | Middle | 3 | 0.203 | 0.158 | 0.000 < P < 0.539 | 20 | 0.000 | 0.000 | 0.000 < P < 0.000 |
| | | Upper | 6 | 0.577 | 0.207 | 0.136 < P < 1.000 | 65 | 0.915 | 0.054 | 0.799 < P < 1.000 |

[a] Simultaneous confidence intervals are calculated as $p \pm ((z_{(alpha/2k)})(\text{S.E. of } p))$, where $k=3$ and $z_{(alpha/2k)}=2.128$.

Table 5. Classification of age-1.3 and -1.4 chinook salmon catches by run and fishing period for the commercial fishery in Yukon River District 1, 1995.

| Commercial Fishing Period | Dates and Mesh Size | Region of Origin | Age Group 1.3 | Age Group 1.4 | Total |
|---|---|---|---|---|---|
| 1 | 6/12-13 | Lower | 264 | 50 | 314 |
| | | Middle | 200 | 0 | 200 |
| | Unrestricted | Alaska | 464 | 50 | 514 |
| | | Upper | 1,062 | 16,021 | 17,083 |
| | | Total | 1,526 | 16,071 | 17,597 |
| 2 | 6/15-16 | Lower | 823 | 1,762 | 2,585 |
| | | Middle | 0 | 1,802 | 1,802 |
| | Unrestricted | Alaska | 823 | 3,564 | 4,387 |
| | | Upper | 1,697 | 9,804 | 11,501 |
| | | Total | 2,520 | 13,368 | 15,888 |
| 3 | 6/19 | Lower | 517 | 182 | 699 |
| | | Middle | 333 | 1,513 | 1,846 |
| | Unrestricted | Alaska | 849 | 1,695 | 2,544 |
| | | Upper | 121 | 3,435 | 3,557 |
| | | Total | 970 | 5,131 | 6,101 |
| 4 | 6/22-23 | Lower | 469 | 5,129 | 5,598 |
| | | Middle | 0 | 3,318 | 3,318 |
| | Unrestricted | Alaska | 469 | 8,447 | 8,916 |
| | | Upper | 1,462 | 8,855 | 10,317 |
| | | Total | 1,931 | 17,297 | 19,228 |
| 5 | 6/26-27 | Lower | 700 | 4,119 | 4,818 |
| | | Middle | 0 | 2,223 | 2,223 |
| | Unrestricted | Alaska | 700 | 6,341 | 7,041 |
| | | Upper | 768 | 2,589 | 3,357 |
| | | Total | 1,468 | 8,930 | 10,398 |
| 6 | 6/27 | Lower | 12 | 21 | 33 |
| | | Middle | 0 | 11 | 11 |
| | Restricted | Alaska | 12 | 33 | 44 |
| | | Upper | 13 | 13 | 26 |
| | | Total | 24 | 46 | 70 |
| 7 | 6/28-29 | Lower | 89 | 183 | 271 |
| | | Middle | 0 | 99 | 99 |
| | Restricted | Alaska | 89 | 281 | 370 |
| | | Upper | 97 | 115 | 212 |
| | | Total | 186 | 396 | 582 |
| 8-11 | 6/30-7/7 | Lower | 24 | 147 | 171 |
| | | Middle | 0 | 79 | 79 |
| | Restricted | Alaska | 24 | 227 | 250 |
| | | Upper | 26 | 93 | 119 |
| | | Total | 50 | 319 | 369 |
| District 1 Season Total | | Lower | 2,897 | 11,593 | 14,489 |
| | | Middle | 532 | 9,045 | 9,578 |
| | | Alaska | 3,429 | 20,638 | 24,067 |
| | | Upper | 5,247 | 40,926 | 46,173 |
| | | Total | 8,676 | 61,564 | 70,240 |

Table 6. Classification of age-1.3 and -1.4 chinook salmon catches by run and fishing period for the commercial fishery in Yukon River District 2, 1995.

| Commercial Fishing Period | Dates and Mesh Size | Region of Origin | Age Group | | Total |
|---|---|---|---|---|---|
| | | | 1.3 | 1.4 | |
| 1 | 6/11-12 | Lower | 285 | 521 | 806 |
| | | Middle | 0 | 1,146 | 1,146 |
| | Unrestricted | Alaska | 285 | 1,667 | 1,952 |
| | | Upper | 443 | 8,779 | 9,222 |
| | | Total | 728 | 10,419 | 11,147 |
| 2 | 6/14 | Lower | 60 | 1,658 | 1,719 |
| | | Middle | 486 | 213 | 699 |
| | Unrestricted | Alaska | 547 | 1,871 | 2,418 |
| | | Upper | 653 | 5,605 | 6,258 |
| | | Total | 1,200 | 7,476 | 8,676 |
| 3 | 6/18 | Lower | 299 | 0 | 299 |
| | | Middle | 274 | 487 | 761 |
| | Unrestricted | Alaska | 574 | 487 | 1,060 |
| | | Upper | 781 | 7,595 | 8,377 |
| | | Total | 1,355 | 8,082 | 9,437 |
| 4 | 6/19 | Lower | 61 | 19 | 80 |
| | | Middle | 56 | 13 | 69 |
| | Restricted | Alaska | 117 | 32 | 149 |
| | | Upper | 159 | 414 | 573 |
| | | Total | 275 | 447 | 722 |
| 5 | 6/21-22 | Lower | 281 | 583 | 865 |
| | | Middle | 258 | 0 | 258 |
| | Unrestricted | Alaska | 540 | 583 | 1,123 |
| | | Upper | 735 | 6,255 | 6,990 |
| | | Total | 1,275 | 6,838 | 8,113 |
| District 2 | | Lower | 987 | 2,782 | 3,768 |
| Season Total | | Middle | 1,074 | 1,859 | 2,934 |
| | | Alaska | 2,061 | 4,641 | 6,702 |
| | | Upper | 2,771 | 28,648 | 31,419 |
| | | Total | 4,833 | 33,289 | 38,121 |

Table 7. Total commercial and subsistence catch of chinook salmon by age class and run in Yukon River Districts 1-6 and Canada, 1995.

| | | | Brood Year and Age Group | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1992 | | 1991 | | 1990 | | | 1989 | | 1988 | | 1987 | | |
| District | Fishery | Run of Origin | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 2.2 | 1.4 | 2.3 | 1.5 | 2.4 | 1.6 | 2.5 | Total |
| 1 | Commercial Gillnet | Lower | 0 | 0 | 0 | 787 | 0 | 2,897 | 0 | 11,593 | 21 | 459 | 0 | 12 | 0 | 15,768 |
| | | Middle | 0 | 0 | 0 | 56 | 0 | 532 | 0 | 9,045 | 16 | 325 | 203 | 9 | 0 | 10,187 |
| | | **Alaska** | 0 | 0 | 0 | 843 | 0 | 3,429 | 0 | 20,638 | 37 | 783 | 203 | 21 | 0 | 25,956 |
| | | Upper | 0 | 0 | 0 | 1,608 | 0 | 5,247 | 0 | 40,926 | 74 | 2,252 | 0 | 43 | 0 | 50,150 |
| | | **Total** | 0 | 0 | 0 | 2,451 | 0 | 8,676 | 0 | 61,564 | 111 | 3,035 | 203 | 65 | 0 | 76,106 |
| | Subsistence Gillnet[b] | Lower | 0 | 0 | 0 | 41 | 0 | 223 | 0 | 1,323 | 5 | 29 | 0 | 0 | 0 | 1,621 |
| | | Middle | 0 | 0 | 0 | 3 | 0 | 41 | 0 | 1,032 | 4 | 21 | 0 | 0 | 0 | 1,100 |
| | | **Alaska** | 0 | 0 | 0 | 44 | 0 | 264 | 0 | 2,355 | 8 | 50 | 0 | 0 | 0 | 2,721 |
| | | Upper | 0 | 0 | 0 | 84 | 0 | 403 | 0 | 4,670 | 16 | 143 | 0 | 0 | 0 | 5,317 |
| | | **Total**[a] | 0 | 0 | 0 | 129 | 0 | 667 | 0 | 7,025 | 24 | 193 | 0 | 0 | 0 | 8,038 |
| 2 | Commercial Gillnet | Lower | 0 | 9 | 0 | 425 | 0 | 987 | 0 | 2,782 | 12 | 64 | 0 | 0 | 0 | 4,278 |
| | | Middle | 0 | 10 | 0 | 181 | 0 | 1,074 | 0 | 1,859 | 8 | 39 | 193 | 0 | 0 | 3,364 |
| | | **Alaska** | 0 | 18 | 0 | 601 | 0 | 2,061 | 0 | 4,641 | 20 | 101 | 193 | 0 | 0 | 7,641 |
| | | Upper | 0 | 25 | 0 | 1,343 | 0 | 2,771 | 0 | 28,648 | 121 | 907 | 0 | 0 | 0 | 33,815 |
| | | **Total** | 0 | 43 | 0 | 1,949 | 0 | 4,833 | 0 | 33,289 | 141 | 1,010 | 193 | 0 | 0 | 41,458 |
| | Subsistence Gillnet[d] | Lower | 0 | 0 | 0 | 32 | 0 | 112 | 0 | 654 | 4 | 28 | 0 | 0 | 0 | 829 |
| | | Middle | 0 | 0 | 0 | 13 | 0 | 122 | 0 | 437 | 3 | 17 | 100 | 0 | 0 | 692 |
| | | **Alaska** | 0 | 0 | 0 | 45 | 0 | 233 | 0 | 1,091 | 6 | 45 | 100 | 0 | 0 | 1,521 |
| | | Upper | 0 | 0 | 0 | 101 | 0 | 314 | 0 | 6,735 | 39 | 401 | 0 | 0 | 0 | 7,590 |
| | | **Total**[c] | 0 | 0 | 0 | 146 | 0 | 547 | 0 | 7,826 | 46 | 446 | 100 | 0 | 0 | 9,111 |
| 3 | Commercial Gillnet[d] | Lower | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Middle | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | **Alaska** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Upper | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | **Total** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Subsistence Gillnet[d] | Lower | 0 | 0 | 0 | 18 | 0 | 64 | 0 | 377 | 2 | 16 | 0 | 0 | 0 | 478 |
| | | Middle | 0 | 0 | 0 | 8 | 0 | 70 | 0 | 252 | 1 | 10 | 58 | 0 | 0 | 399 |
| | | **Alaska** | 0 | 0 | 0 | 26 | 0 | 135 | 0 | 630 | 4 | 26 | 58 | 0 | 0 | 878 |
| | | Upper | 0 | 0 | 0 | 58 | 0 | 181 | 0 | 3,887 | 23 | 232 | 0 | 0 | 0 | 4,380 |
| | | **Total** | 0 | 0 | 0 | 84 | 0 | 315 | 0 | 4,517 | 26 | 258 | 58 | 0 | 0 | 5,258 |
| 4 | Commercial & Subsistence GN & FW[e] | Lower | 0 | 2 | 0 | 88 | 0 | 205 | 0 | 579 | 2 | 13 | 0 | 0 | 0 | 890 |
| | | Middle | 0 | 2 | 0 | 67 | 0 | 488 | 0 | 1,338 | 7 | 45 | 258 | 0 | 0 | 2,205 |
| | | **Alaska** | 0 | 4 | 0 | 155 | 0 | 693 | 0 | 1,917 | 10 | 58 | 258 | 0 | 0 | 3,095 |
| | | Upper | 0 | 5 | 0 | 280 | 0 | 577 | 0 | 5,963 | 25 | 189 | 0 | 0 | 0 | 7,038 |
| | | **Total** | 0 | 9 | 0 | 435 | 0 | 1,270 | 0 | 7,879 | 35 | 247 | 258 | 0 | 0 | 10,134 |

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Table 7. (Page 2 of 2)

| | | | Brood Year and Age Group | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1992 | | 1991 | | 1990 | | | 1989 | | 1988 | | 1987 | | |
| District | Fishery | Run of Origin | 0.2 | 1.1 | 0.3 | 1.2 | 0.4 | 1.3 | 2.2 | 1.4 | 2.3 | 1.5 | 2.4 | 1.6 | 2.5 | Total |
| 5 | Commercial & Subsistence GN & FW[f] | Middle | 0 | 2 | 0 | 44 | 0 | 240 | 0 | 129 | 0 | 20 | 0 | 0 | 0 | 434 |
| | | **Alaska** | 0 | 2 | 0 | 44 | 0 | 240 | 0 | 129 | 0 | 20 | 0 | 0 | 0 | 434 |
| | | Upper | 0 | 69 | 0 | 1,988 | 0 | 10,900 | 0 | 5,827 | 0 | 891 | 0 | 0 | 0 | 19,674 |
| | | **Total** | 0 | 70 | 0 | 2,032 | 0 | 11,140 | 0 | 5,955 | 0 | 911 | 0 | 0 | 0 | 20,108 |
| 6 | Commercial & Subsistence GN & FW[g] | Middle | 0 | 414 | 0 | 1,076 | 0 | 3,187 | 0 | 2,608 | 0 | 166 | 0 | 0 | 0 | 7,450 |
| Canada[h] | Commercial GN & FW | Upper | 0 | 335 | 12 | 1,219 | 24 | 6,355 | 12 | 2,760 | 36 | 323 | 60 | 0 | 12 | 11,146 |
| | Non-commercial | Upper | 0 | 292 | 10 | 1,065 | 21 | 5,554 | 10 | 2,412 | 31 | 282 | 52 | 0 | 10 | 9,741 |
| TOTAL HARVEST | | Lower | 0 | 11 | 0 | 1,392 | 0 | 4,488 | 0 | 17,308 | 46 | 609 | 0 | 12 | 0 | **23,864** |
| | | Middle | 0 | 427 | 0 | 1,448 | 0 | 5,754 | 0 | 16,699 | 39 | 642 | 813 | 9 | 0 | **25,832** |
| | | **Alaska** | 0 | 438 | 0 | 2,840 | 0 | 10,242 | 0 | 34,007 | 84 | 1,251 | 813 | 21 | 0 | **49,696** |
| | | Upper | 0 | 725 | 22 | 7,745 | 45 | 32,304 | 22 | 101,828 | 365 | 5,620 | 112 | 43 | 22 | **148,854** |
| | | **Total** | 0 | 1,163 | 22 | 10,585 | 45 | 42,546 | 22 | 135,835 | 450 | 6,871 | 925 | 64 | 22 | **198,550** |

[a] Includes 2,078 fish from ADF&G test fisheries.

[b] Run composition is based on District 1, period 1 commercial catch samples.

[c] Includes 74 fish from ADF&G test fisheries.

[d] Run composition based on District 2, period 1 commercial catch samples.

[e] Gillnet and fish wheel catches combined. Commercial catch = 262 fish, commercial related catch = 237, and subsistence catch = 8,130. The Koyukuk River subsistence catch (1,505) was assigned to the Middle River Run (see METHODS).

[f] Gillnet and fish wheel catches combined. Commercial catch = 3,242 and subsistence catch = 16,432 plus 434 from the Chandalar and Black Rivers.

[g] Gillnet and fish wheel catches combined. Data includes 1,660 commercial, 1,087 commercial related, 1,779 subsistence, 399 personal use, and 2,525 sport harvest.

[h] Run and age composition are based on Canada DFO tagging study fish wheel samples. Harvest components include commercial (11,146), Canadian Aboriginal fishery (9,041), and sport (700) harvests.

Table 8. Harvest percentages by run of the total Yukon River harvest of chinook salmon, 1982-95.

| Year | Lower Run | Middle Run | Upper Run |
|---|---|---|---|
| 1982 | 13.5 | 23.7 | 62.8 |
| 1983 | 12.4 | 36.8 | 50.8 |
| 1984 | 29.0 | 35.6 | 35.4 |
| 1985 | 30.9 | 19.5 | 49.6 |
| 1986 | 26.5 | 5.6 | 67.9 |
| 1987 | 16.5 | 17.3 | 66.2 |
| 1988 | 27.2 | 11.3 | 61.4 |
| 1989 | 25.7 | 15.9 | 58.4 |
| 1990 | 19.3 | 22.2 | 58.5 |
| 1991 | 26.1 | 29.0 | 44.9 |
| 1992 | 17.5 | 23.2 | 59.3 |
| 1993 | 22.3 | 13.2 | 64.6 |
| 1994 | 16.1 | 24.4 | 59.6 |
| 1995 | 12.0 | 13.1 | 74.9 |
| 1982-95 Avg | 21.1 | 20.8 | 58.2 |
| 1991-95 Avg | 18.8 | 20.6 | 60.7 |

**FIGURES**

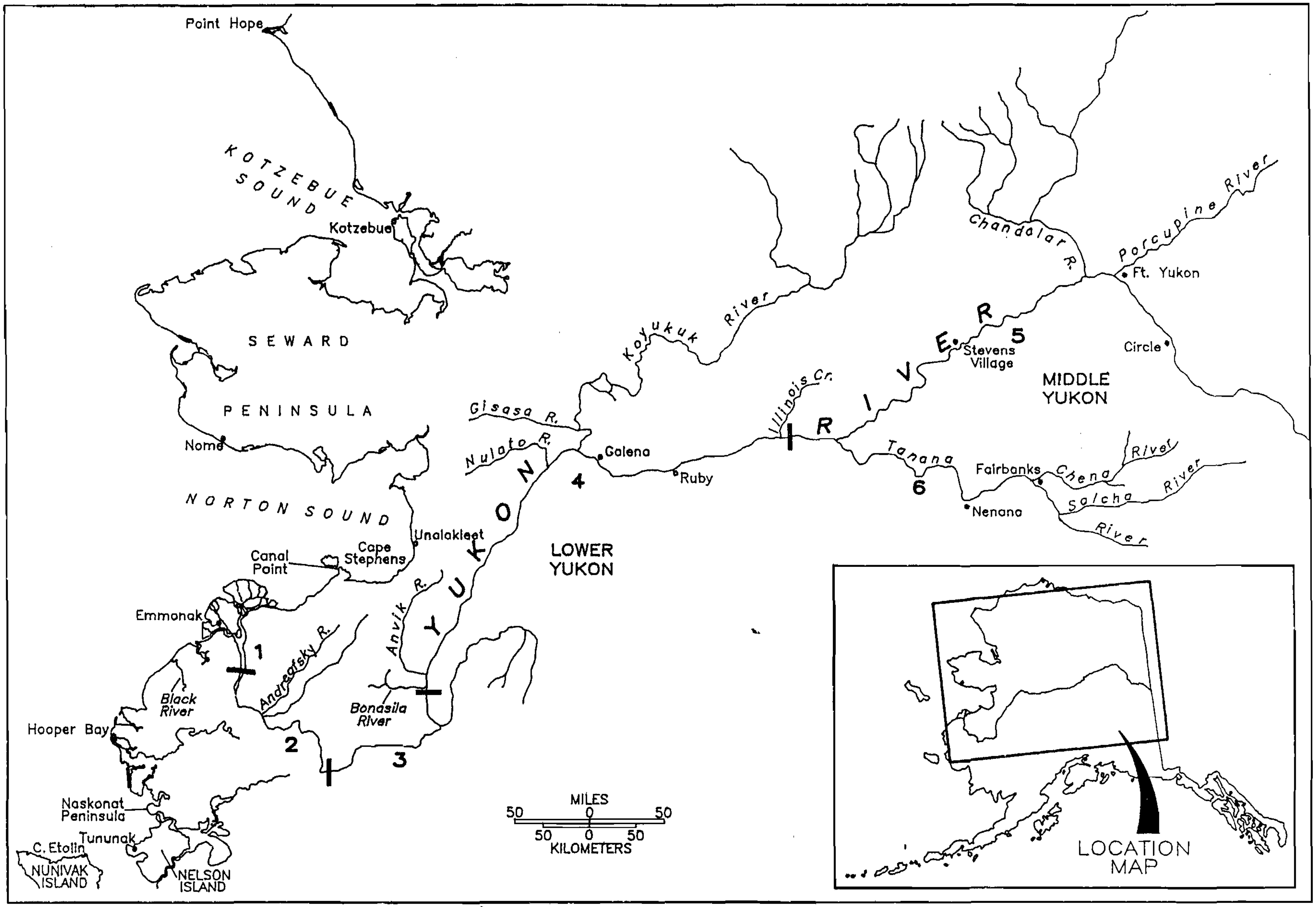


Figure 1. Alaskan portion of the Yukon River with fishing district boundaries.

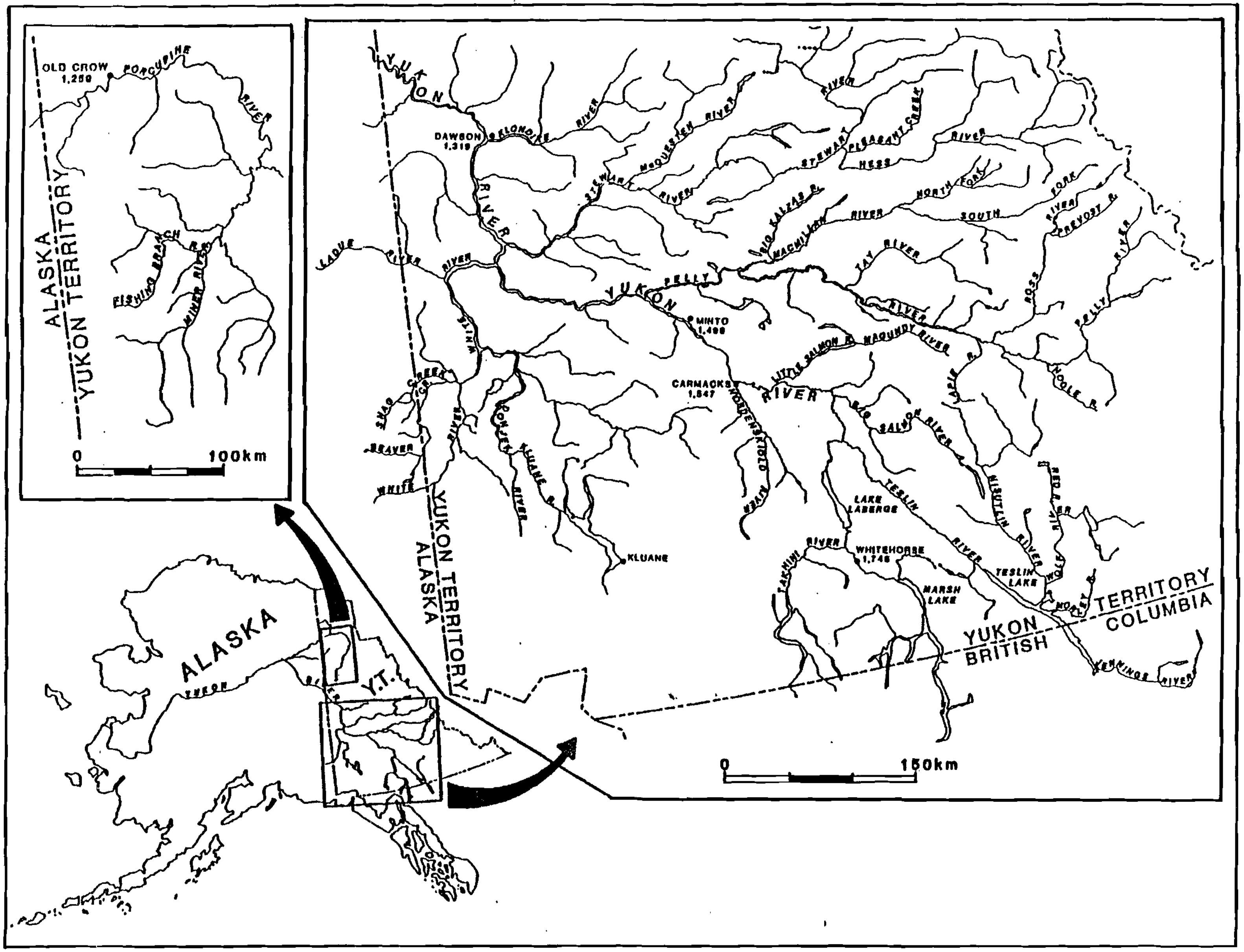


Figure 2. Canadian portion of the Yukon River drainage.

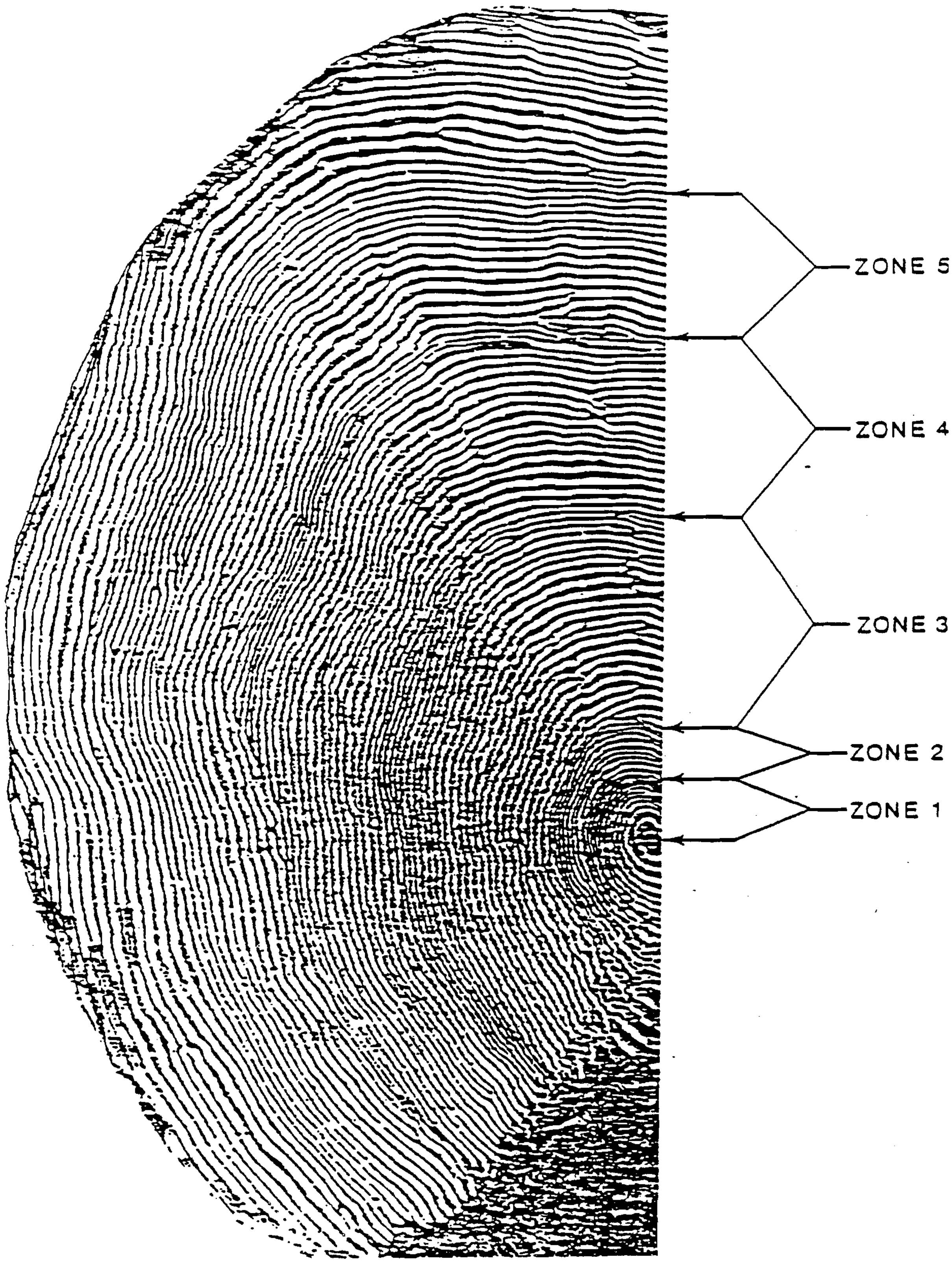


Figure 3. Age-1.4 chinook salmon scale showing zones measured for linear discriminant analysis.

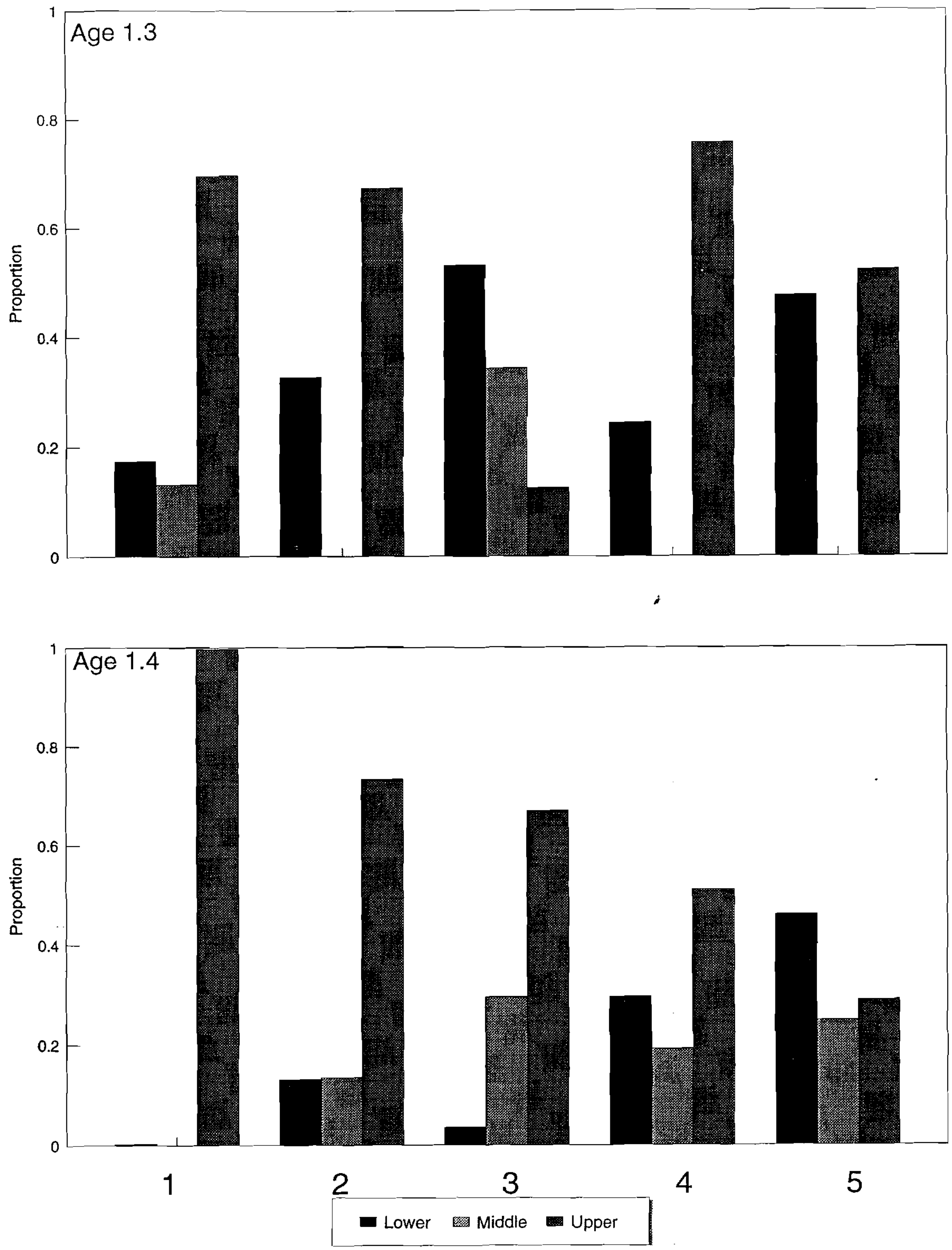


Figure 4. Estimated proportion of catch by period (all periods unrestricted mesh size) and run from scale pattern analysis of age-1.3 and -1.4 chinook salmon, Yukon River District 1, 1995.

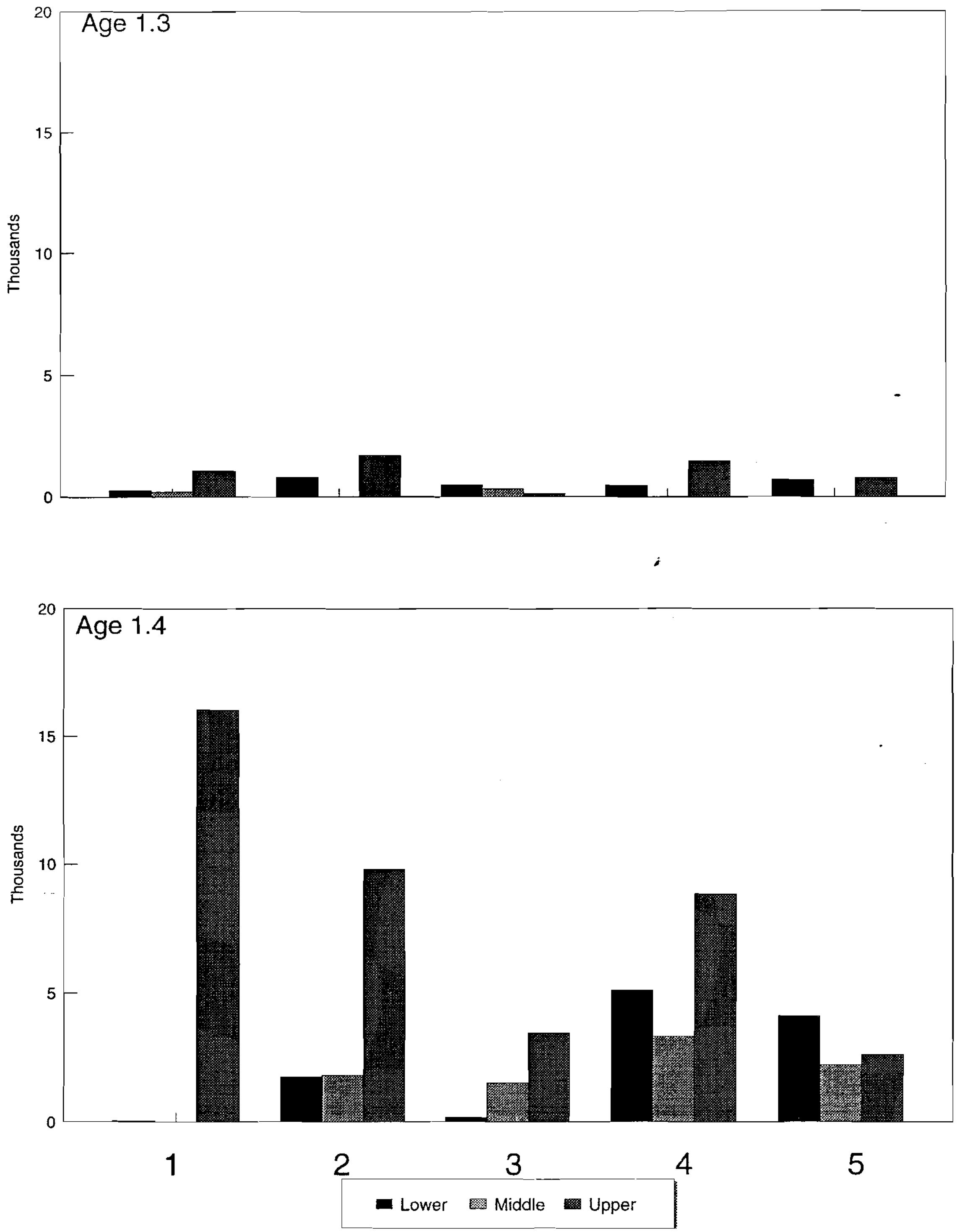


Figure 5. Estimated catch by period (all periods unrestricted mesh size) and run in numbers of fish from scale pattern analysis of age-1.3 and -1.4 chinook salmon, Yukon River District 1, 1995.

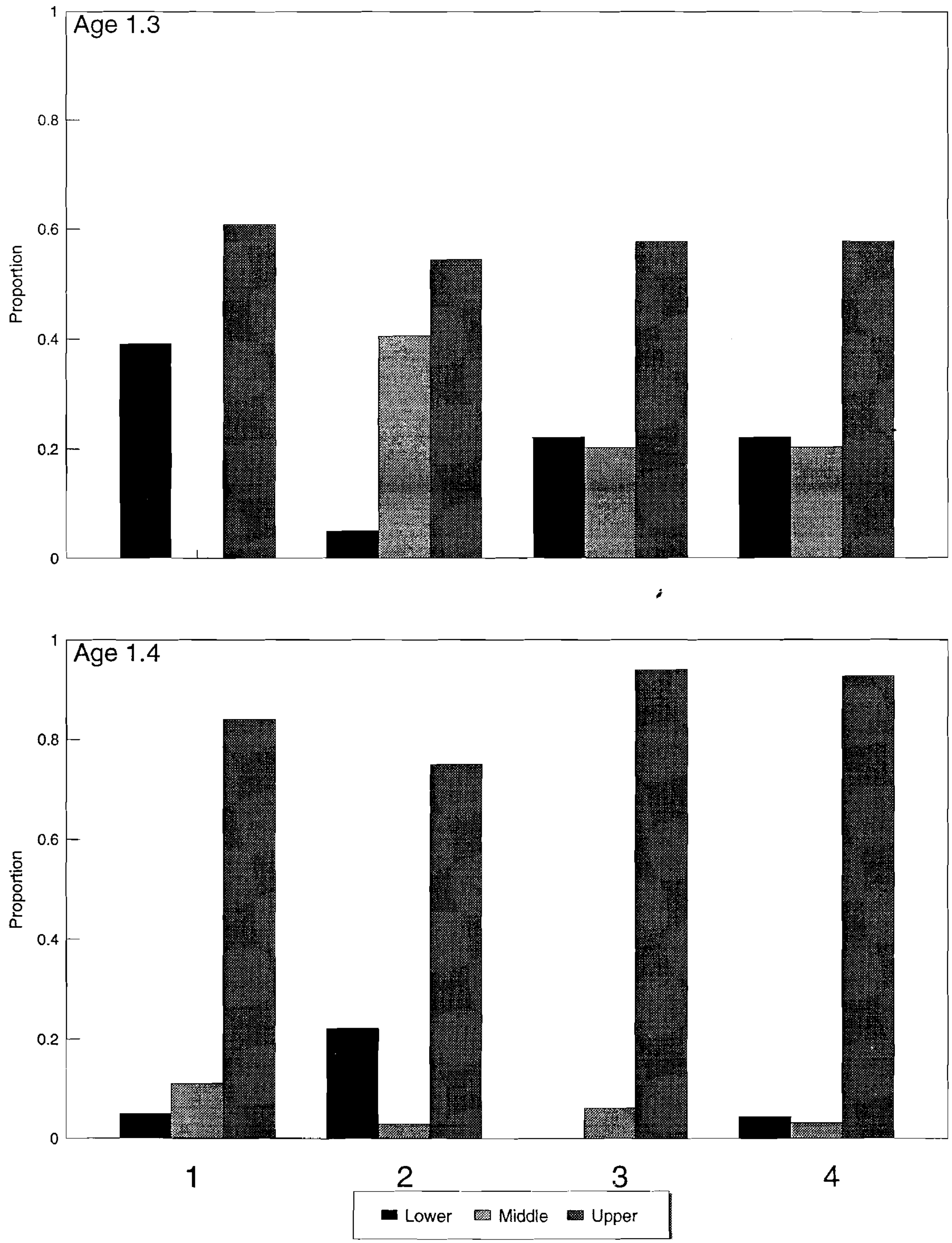


Figure 6. Estimated proportion of catch by period (all periods unrestricted mesh size) and run from scale pattern analysis of age-1.3 and -1.4 chinook salmon, Yukon River District 2, 1995.

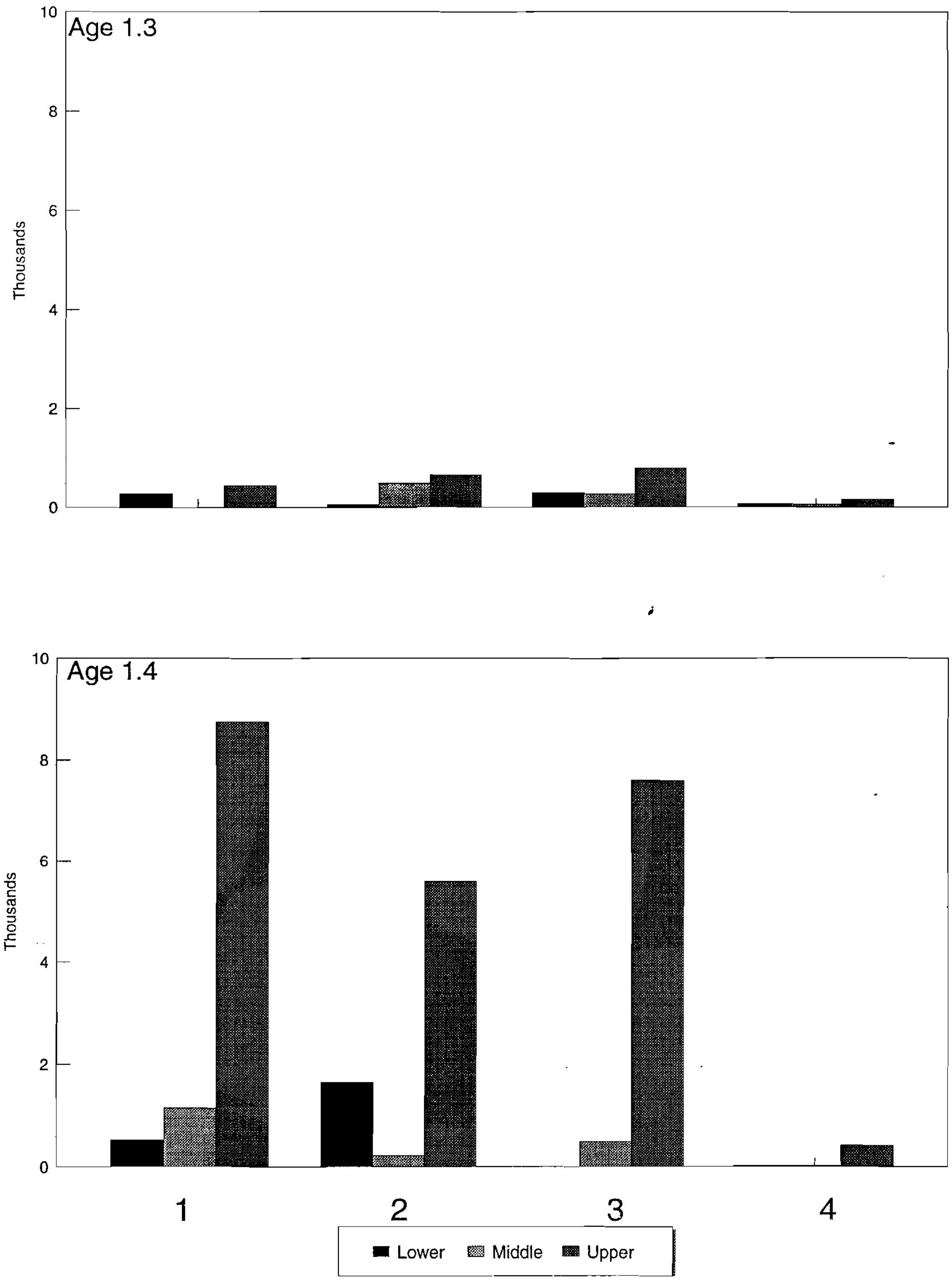


Figure 7. Estimated catch by period (all periods unrestricted mesh size) and run in numbers of fish from scale pattern analysis of age-1.3 and -1.4 chinook salmon, Yukon River District 2, 1995.

**APPENDIX**

Appendix A. Scale variables screened for linear discriminant function analysis of age-1.3 and -1.4 Yukon River chinook salmon, 1995.

| Variable | 1st Freshwater Annular Zone |
|---|---|
| 1 | Number of Circuli (NC1FW)[a] |
| 2 | Width of Zone (S1FW)[b] |
| 3 (16) | Distance, scale focus (C0) to circulus 2 (C2) |
| 4 | Distance, C0-C4 |
| 5 (18) | Distance, C0-C6 |
| 6 | Distance, C0-C8 |
| 7 (20) | Distance, C2-C4 |
| 8 | Distance, C2-C6 |
| 9 (22) | Distance, C2-C8 |
| 10 | Distance, C4-C6 |
| 11 (24) | Distance, C4-C8 |
| 12 | Distance, C(NC1FW -4) to end of zone |
| 13 (26) | Distance, C(NC1FW -2) to end of zone |
| 14 | Distance, C2 to end of zone |
| 15 | Distance, C4 to end of zone |
| 16-26 | Relative widths, (variables 3-13)/S1FW |
| 27 | Average interval between circuli, S1FW/NC1FW |
| 28 | Number of circuli in first 3/4 of zone |
| 29 | Maximum distance between 2 consecutive circuli |
| 30 | Relative width, (variable 29)/S1FW |

| Variable | Freshwater Plus Growth |
|---|---|
| 61 | Number of Circuli (NCPG)[c] |
| 62 | Width of Zone (SPGZ)[d] |

| Variable | All Freshwater Zones |
|---|---|
| 65 | Total number of freshwater circuli (NC1FW+NCPG) |
| 66 | Total width of freshwater zone (S1FW+SPGZ) |
| 67 | Relative width, S1FW/(S1FW+SPGZ) |

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| Variable | | 1st Marine Annular Zone |
|---|---|---|
| 70 | | Number of circuli (NC1OZ)[e] |
| 71 | | Width of zone (S1OZ)[f] |
| 72 | (90) | Distance, end of freshwater growth (EFW) to C3 |
| 73 | | Distance, EFW-C6 |
| 74 | (92) | Distance, EFW-C9 |
| 75 | | Distance, EFW-C12 |
| 76 | (94) | Distance, EFW-C15 |
| 77 | | Distance, C3-C6 |
| 78 | (96) | Distance, C3-C9 |
| 79 | | Distance, C3-C12 |
| 80 | (98) | Distance, C3-C15 |
| 81 | | Distance, C6-C9 |
| 82 | (100) | Distance, C6-C12 |
| 83 | | Distance, C6-C15 |
| 84 | (102) | Distance, C(NC1OZ -6) to end of zone |
| 85 | | Distance, C(NC1OZ -3) to end of zone |
| 86 | (104) | Distance, C3 to end of zone |
| 87 | | Distance, C9 to end of zone |
| 88 | | Distance, C15 to end of zone |
| 90-104 | | Relative widths, (variables 73-86)/S1OZ |
| 105 | | Average interval between circuli, S1OZ/NC1OZ |
| 106 | | Number of circuli in first 1/2 of zone |
| 107 | | Maximum distance between 2 consecutive circuli |
| 108 | | Relative width, (variable 107)/S1OZ |

| Variable | All Marine Zones |
|---|---|
| 109 | Width of 2nd Marine zone, (S2OZ) |
| 110 | Width of 3rd Marine zone, (S3OZ) |
| 111 | Total width of marine zones (S1OZ+S2OZ+S3OZ) |
| 112 | Relative width, S1OZ/(S1OZ+S2OZ+S3OZ) |
| 113 | Relative width, S2OZ/(S1OZ+S2OZ+S3OZ) |

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[a] Number of circuli, 1st freshwater zone.
[b] Size (axial length) 1st freshwater zone.
[c] Number of circuli, plus growth zone.
[d] Size (axial length) plus growth zone.
[e] Number of circuli, 1st ocean zone.
[f] Size (axial length) 1st ocean zone.

Appendix B. Group means, standard errors, and one-way analysis of variance F-statistic for scale variables selected for use in linear discriminant models of age-1.3 and -1.4 Yukon River chinook salmon runs, 1995.

| | | Lower | | Middle | | Upper | |
|---|---|---|---|---|---|---|---|
| Growth Zone | Variable | Mean | SE | Mean | SE | Mean | SE |
| Age-1.3 | | | | | | | |
| 1st FW Annular | 15 | 75.51 | 3.04 | 75.50 | 2.46 | 113.38 | 4.90 |
| All Freshwater | 66 | 186.95 | 2.67 | 173.82 | 3.04 | 214.38 | 6.56 |
| All Marine | 111 | 1033.19 | 24.32 | 892.50 | 15.71 | 821.75 | 22.97 |
| Age-1.4 | | | | | | | |
| 1st FW Annular | 1 | 12.12 | 0.18 | 12.85 | 0.13 | 14.81 | 0.16 |
| | 8 | 44.94 | 0.52 | 41.48 | 0.47 | 44.56 | 0.79 |
| | 12 | 39.44 | 0.55 | 43.54 | 0.51 | 46.39 | 0.69 |
| | 15 | 78.49 | 1.78 | 89.88 | 1.52 | 117.38 | 2.15 |
| | 18 | 0.64 | 0.01 | 0.57 | <0.01 | 0.49 | <0.01 |
| 1st Marine Annular | 82 | 115.29 | 1.20 | 120.37 | 1.04 | 131.34 | 1.46 |
| | 107 | 29.25 | 0.31 | 27.66 | 0.25 | 29.00 | 0.38 |
| All Marine | 111 | 1344.86 | 10.49 | 1239.89 | 9.32 | 1249.00 | 11.10 |

Appendix C. Group means, standard errors, and one-way analysis of variance F-statistic for the number of circuli and incremental distance of salmon scale growth zone measurements from age-1.3 and -1.4 Yukon River chinook salmon runs, 1995.

| Growth Zone | Variable | Description | Lower Mean | Lower SE | Middle Mean | Middle SE | Upper Mean | Upper SE | F-Value |
|---|---|---|---|---|---|---|---|---|---|
| <u>Age-1.3</u> | | | | | | | | | |
| 1st FW Annular | 1 | No. Circ. | 11.695 | 0.300 | 11.833 | 0.227 | 14.563 | 0.418 | 13.985 |
| | 2 | Distance | 157.780 | 2.490 | 147.593 | 2.837 | 185.938 | 6.192 | 21.461 |
| Total FW Growth | 61 | No. Circ | 2.237 | 0.065 | 2.074 | 0.036 | 2.250 | 0.112 | 2.553 |
| | 62 | Distance | 29.169 | 0.707 | 26.222 | 0.738 | 28.438 | 1.663 | 4.025 |
| 1st Ocean Ann. | 70 | No. Circ. | 29.237 | 1.002 | 25.778 | 0.685 | 21.563 | 0.555 | 10.976 |
| | 71 | Distance | 559.729 | 18.569 | 468.704 | 12.135 | 427.250 | 11.124 | 13.309 |
| 2nd Ocean Ann. | 109 | Distance | 473.458 | 11.970 | 423.796 | 11.694 | 394.500 | 17.992 | 7.373 |
| <u>Age-1.4</u> | | | | | | | | | |
| 1st FW Annular | 1 | No. Circ. | 12.117 | 0.173 | 12.852 | 0.128 | 14.810 | 0.163 | 59.419 |
| | 2 | Distance | 155.313 | 1.872 | 162.995 | 1.593 | 190.460 | 2.265 | 74.106 |
| Total FW Growth | 61 | No. Circ. | 2.184 | 0.037 | 2.219 | 0.029 | 2.250 | 0.044 | 0.725 |
| | 62 | Distance | 29.319 | 0.595 | 30.595 | 0.488 | 31.540 | 0.704 | 3.111 |
| 1st Ocean Ann. | 70 | No. Circ. | 26.816 | 0.265 | 24.505 | 0.219 | 23.610 | 0.271 | 38.875 |
| | 71 | Distance | 509.871 | 5.092 | 458.781 | 4.639 | 466.080 | 5.893 | 30.651 |
| 2nd Ocean Ann. | 109 | Distance | 383.327 | 4.244 | 359.257 | 3.564 | 373.990 | 5.668 | 9.485 |
| 3rd Ocean Ann. | 110 | Distance | 459.652 | 4.871 | 421.852 | 4.424 | 408.930 | 4.612 | 27.565 |